REMARKS

Applicants have cancelled claims 1-14 without prejudice. Claims 15-43 are pending in the application. All of the pending claims were rejected or objected to on various grounds, each of which is addressed below.

Rejections under 35 U.S.C. §102(b)

Claims 1-4, 7-11, 14-23, and 26-33 stand rejected under 35 U.S.C. §102(b) as anticipated by U.S. Patent No. 3,945,847 (Kordesch). Claims 1-14 have been cancelled, rendering the rejection of these claims moot.

Claim 15 is directed to an air recovery battery including a container with an air access port, which allows air to enter the battery during use. Air access is critical to an air recovery battery because oxygen from the air that enters the battery refreshes the manganese dioxide catalyst in the cathode, thus allowing the battery to be recharged during rest cycles and during periods of low discharge rates.

Kordesch shows a battery with a "filling port," but does not describe the function of the filling port. A filling port is generally used to fill a battery with electrolyte during assembly of the battery. After the electrolyte has been added, the port is sealed to prevent leakage during battery use. The filling port is described and shown in David Linden, Handbook of Batteries § 14.12.2 and Figure 14.94 (3d ed. 2001) (copy attached as Exhibit A):

> Following welding of the lid to the case, the cell is filled with electrolyte through the fill hole and a stainless steel ball is inserted in the fill port, and an additional plug is then laser welded over the fill hole, providing an hermetic seal.

Thus, the filling port, which is sealed in the finished battery, does not allow oxygen to enter the battery during use. In view of this distinction, applicants submit that Kordesch does not anticipate claim 15 and request that this rejection be withdrawn. Claims 16-23 and 26-33 depend from claim 15, and applicants request that the rejection of these claims be withdrawn as well.

Claims 1-14 stand rejected under 35 U.S.C. §102(e) as anticipated by U.S. Patent No. 6,187,475 (Oh). Claims 1-14 have been cancelled, rendering this rejection moot.

Claim 39 stands rejected under 35 U.S.C. §102(e) as anticipated by U.S. Patent No. 6,183,668 (Debe). Claim 39 is directed to a method for making a rechargeable cathode in which a mixture of a catalyst, carbon particles, and a solvent is combined with a hydrophobic polymer at a temperature below about 10°C to form a paste.

According to the office action, "Debe teaches a method of making a cathode by combining a catalyst, carbon particles, and solvent to form a mixture and adding a hydrophobic polymer (col 1 lines 40-65)." (Office Action at page 4.) Debe, however, does not teach combining a catalyst, carbon particles, solvent, and hydrophobic polymer to form a paste. Instead, Debe describes combining carbon particles, a solvent, and a polymer to form an electrode backing layer. The electrode backing layer does not contain a catalyst. See, e.g., col. 6, lines 51-52 ("The electrode backing layer comprises a porous polymer film including a polymer binder and conductive particles.") and Examples 1-5 of Debe. The electrode backing layer is layered with a separate catalyst-containing layer to form an electrode assembly, as outlined in Debe at col. 4, line 63 to col. 5, line 4:

> Referring to FIG. 1, membrane electrode assembly (MEA) 100 in a five layer embodiment has various layers for the electrochemical oxidation of a fuel and reduction of an oxidizing agent to produce electric current. An ion conductive membrane 102 separates the cathode 104 and anode 106 of MEA 100. Each side of ion conductive membrane 102 contacts a catalyst layer, i.e., cathode 104 and anode 106. Catalyst layers 104, 106 each contact an electrode backing layer 108, 110.

Thus, Debe does not describe combining a catalyst with carbon particles and a polymer to form a paste. Debe therefore does not anticipate claim 39.

Applicants submit, moreover, that the method of claim 39 is nonobvious in view of Debe. In describing the process used to form the electrolyte backing layer, Debe states "The temperature preferably is in the range from about 0°C. and about 100°C., preferably from about 20°C. and about 60°C." In other words, Debe teaches that the preferred temperature is greater than 20°C. Such a teaching does not render obvious a method in which the temperature is less than about 10°C. In view of the above, applicants request that the rejection of this claim under 35 U.S.C. § 102 be withdrawn.

Rejections under 35 U.S.C. §103(a)

Claims 5, 6, 12, 13, 24, and 25 stand rejected under 35 U.S.C. §103(a) as unpatentable over Kordesch in view of U.S. Patent No. 5,677,083 (Tomiyama). Claims 5, 6, 12, and 13 have been cancelled, rendering the rejection of these claims moot. Claims 24 and 25 depend from claim 1 and therefore include the limitation that the air recovery battery of the claim has a container with an air access port. As is discussed above, Kordesch does not teach a container with an air access port, or anything that functions as an air access port. Tomiyama also does not teach an air access port, and applicants submit that the combination of these references does not render the batteries of claims 24 and 25 obvious.

Claims 34-38 stand rejected under 35 U.S.C. §103(a) as unpatentable over Kordesch in view of U.S. Patent No. 5,800,939 (Mishina). Claims 34-38 are directed to a method for making an air recovery battery. The container of the battery includes an air access port. Neither Kordesch nor Mishina describes a container with an air access port or anything that functions as an air access port, and applicants submit that the subject matter of claims 34-38 is nonobvious in view of these references.

Claims 40 and 41 stand rejected under 35 U.S.C. §103(a) as unpatentable over Debe in view of U.S. Patent No. 4,582,553 (Buchta). Claims 40 and 41 depend from claim 39 and thus are directed to a method for making a cathode in which a mixture of a catalyst, carbon particles, and solvent is combined with a hydrophobic polymer at a temperature below about 10°C. Debe, as discussed above, does not disclose a method in which all of these components are combined at such a temperature, and Buchta does not cure the deficiencies of Debe. Applicants submit, therefore, that claims 40 and 41 are patentable in view of these references and request that this rejection be withdrawn.

Attached is a marked-up version of the changes being made by the current amendment.

Applicants ask that all claims be allowed. Enclosed is a $400.00 check for the Petition for Extension of Time fee. Please apply any other charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

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Version with markings to show changes made

In the claims:

Claims 1-14 have been cancelled without prejudice.

HANDBOOK OF BATTERIES

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14.12.1 Chemistry

SVO is produced by the thermal reaction of $AgNO_3$ and V_2O_5.[46] This material belongs to the class of vanadium bronzes and possesses semi-conducting properties. It is reduced chemically and electrochemically in a multi-step process in which V^{+5} is first reduced to V^{+4} in a two-step reaction, followed by reduction of Ag^{+1} to Ag^0 and then by partial reduction of V^{+4} to V^{+3}. These processes tend to overlap and plateaus are observed in the discharge curves at 3.2, 2.8, 2.2 and 1.8 V. When discharged to 1.5 V, 3.5 equivalents of lithium per mole of SVO are utilized based on the empirical formula $AgV_2O_{5.5}$. The following reactions have been proposed to account for this stoichiometry:

Anode: $3.5\ Li \rightarrow 3.5\ Li^+ + 3.5e$

Cathode: $\underline{3.5e + Ag(I)V_2(V)O_{5.5} \rightarrow Ag(0)V_2(IV,III)O_{5.5}}$

Overall: $3.5\ Li + AgV_2O_{5.5} \rightarrow Li_{3.5}AgV_2O_{5.5}$

Electrolytes which have been employed with this system are 1 molar $LiBF_4$ in propylene carbonate (PC) and 1 Molar $LiAsF_6$ in 1:1 by volume PC-DME. The latter appears to be the electrolyte of choice at present. The addition of CO_2 or substances such as dibenzyl carbonate (DBC) or benzyl succinimidyl carbonate have been reported to reduce anode passivation which causes voltage delay and increased DC resistance between 40 and 70% depth of discharge.[48] These materials are believed to operate by lowering the impedance of the solid electrolyte interface (SEI) layer on the surface of the lithium anode.

14.12.2 Construction

Typical construction of a prismatic implantable Li/SVO cell designed for use in a cardiac defibrillator where high power capability is required is shown in Fig. 14.94.[49] The case and lid are made of 304L stainless steel and are the negative cell terminal. A glass-to-metal (GTM) seal employs TA-23 glass and a molybdenum pin. Although this GTM seal is intrinsically corrosion resistant in lithium primary cells, an elastomeric material and an insulating cap are added to the underside of the seal to provide an additional mechanical barrier and enhanced protection for the GTM. Two layers of insulating straps, one a fluropolymer and the other of mica are added to the underside of the lid to prevent contact of the cathode lead to the lid. The anode is constructed of two layers of lithium foil pressed on a nickel screen and heat sealed in a microporous polypropylene separator. The cathode consists of SVO with added carbon, graphite and PTFE binder. A typical composition is 94% SVO, 1% carbon, 2% graphite and 3% PTFE,[50] pressed on a finely meshed titanium screen under high pressure and then heat sealed in a microporous polypropylene separator. One anode assembly is wound around the individual cathode plates as shown in Fig. 14.94 and the anode tabs welded to the case. Six to eight cathode plates are welded to a cathode lead bridge and an insulated tab connects the bridge to the Mo pin of the GTM seal. Following welding of the lid to the case, the cell is filled with electrolyte through the fill hole and a stainless steel ball inserted in the fill port, and an additional plug is then laser welded over the fill hole, providing an hermetic cell.

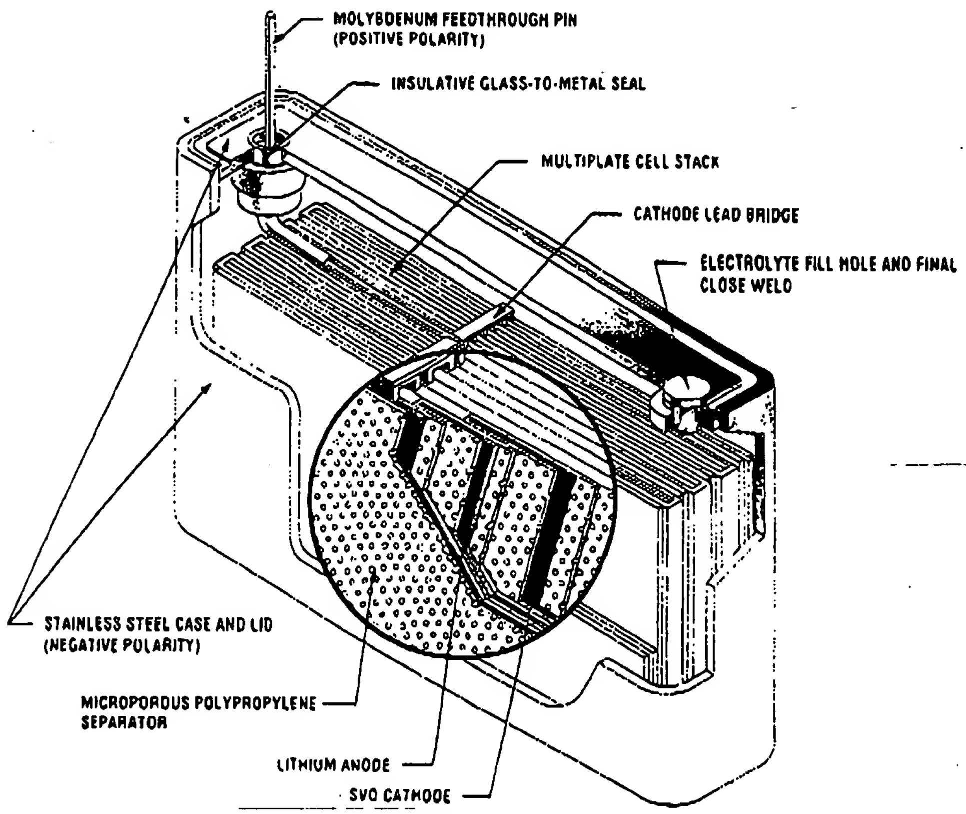

FIGURE 14.94 Construction of a Li/SVO cell designed for use in a cardiac defibrillator. (*Courtesy Wilson Greatbatch, Ltd.*)

Performance

A typical defibrillator operates by sensing fibrillation through two electrodes and delivering 25 to 40 Joule pulses to the heart, when necessary, to paralyze the heart which then recovers to a normal beating rhythm. The power source is required to deliver 10 to 30 microamps continuously for the sensing and/or pacing functions over many years. It must also be capable of providing the energy required to charge the capacitors in the defibrillator. This energy is typically delivered as 1 to 2 Amps for 10 seconds. A typical battery is therefore tested to provide four 2.0 Amp, 10 second pulses with 15 second intervals between pulses.

Figure 14.95 shows the continuous discharge curve for a resistive discharge at the two-year rate. Battery voltage is plotted against lithium equivalents per mole of SVO. Accelerated discharge testing consists of applying a series of four 2.0 Amp, 10 second pulses with 15 second intervals superimposed on a low-rate resistive discharge. Figure 14.96 shows a discharge curve for a 2.2 Ah Li/SVO battery subjected to a series of four pulses every 30 minutes. The voltage on the continuous background load is shown together with the minimum voltage on the first and fourth pulses to a 1.5 V cut-off. Additional testing is carried out with increased intervals between the pulse sequences. Figure 14.97 shows a discharge curve in which four 1.5 Amp, 10 second pulses superimposed on a 17.4 K ohm load are applied every two months to a 1.4 Ah battery. The continuous discharge voltage is plotted as is the fourth pulse minimum voltage which is above 2.0 volts after 45 months.[51]